FIG. 1

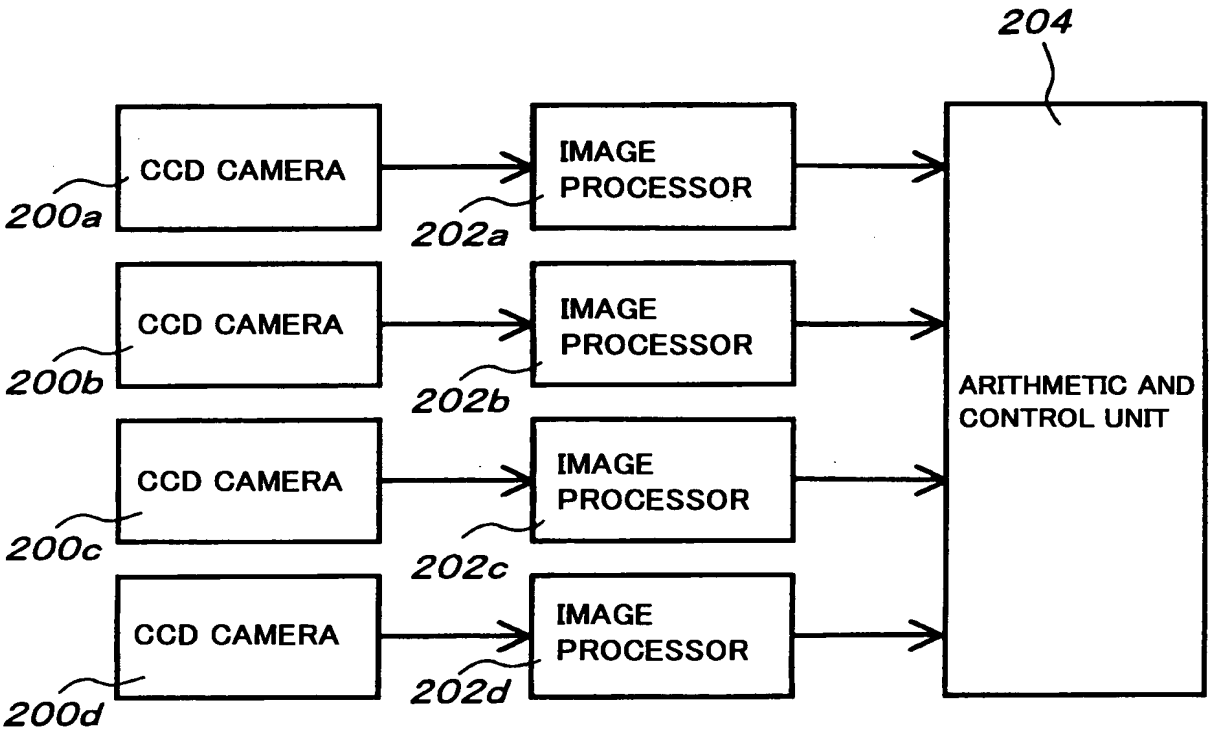

204
CCD CAMERA
200a
IMAGE PROCESSOR
202a
CCD CAMERA
200b
IMAGE PROCESSOR
202b
CCD CAMERA
200c
IMAGE PROCESSOR
202c
CCD CAMERA
200d
IMAGE PROCESSOR
202d
ARITHMETIC AND CONTROL UNIT

FIG. 2

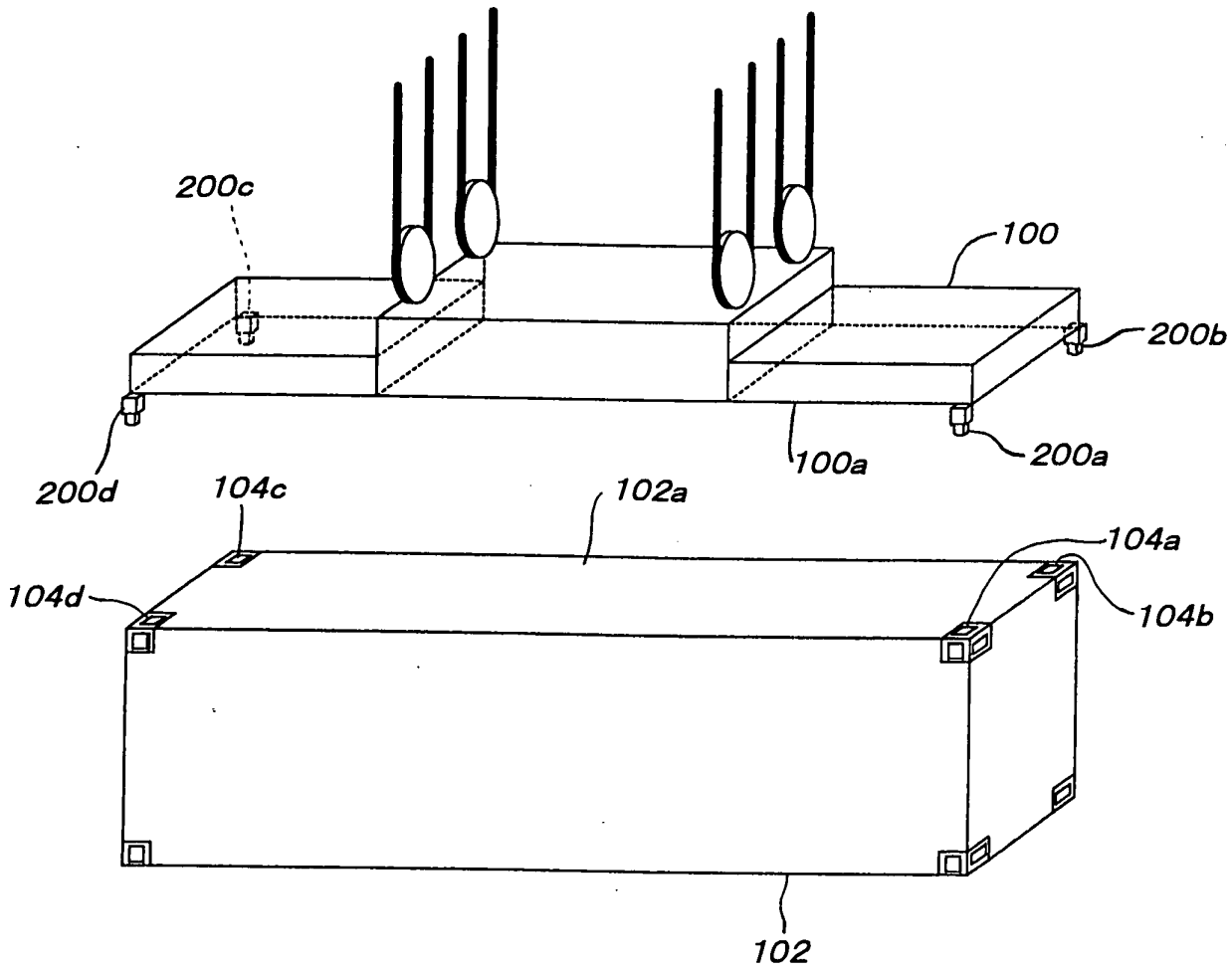
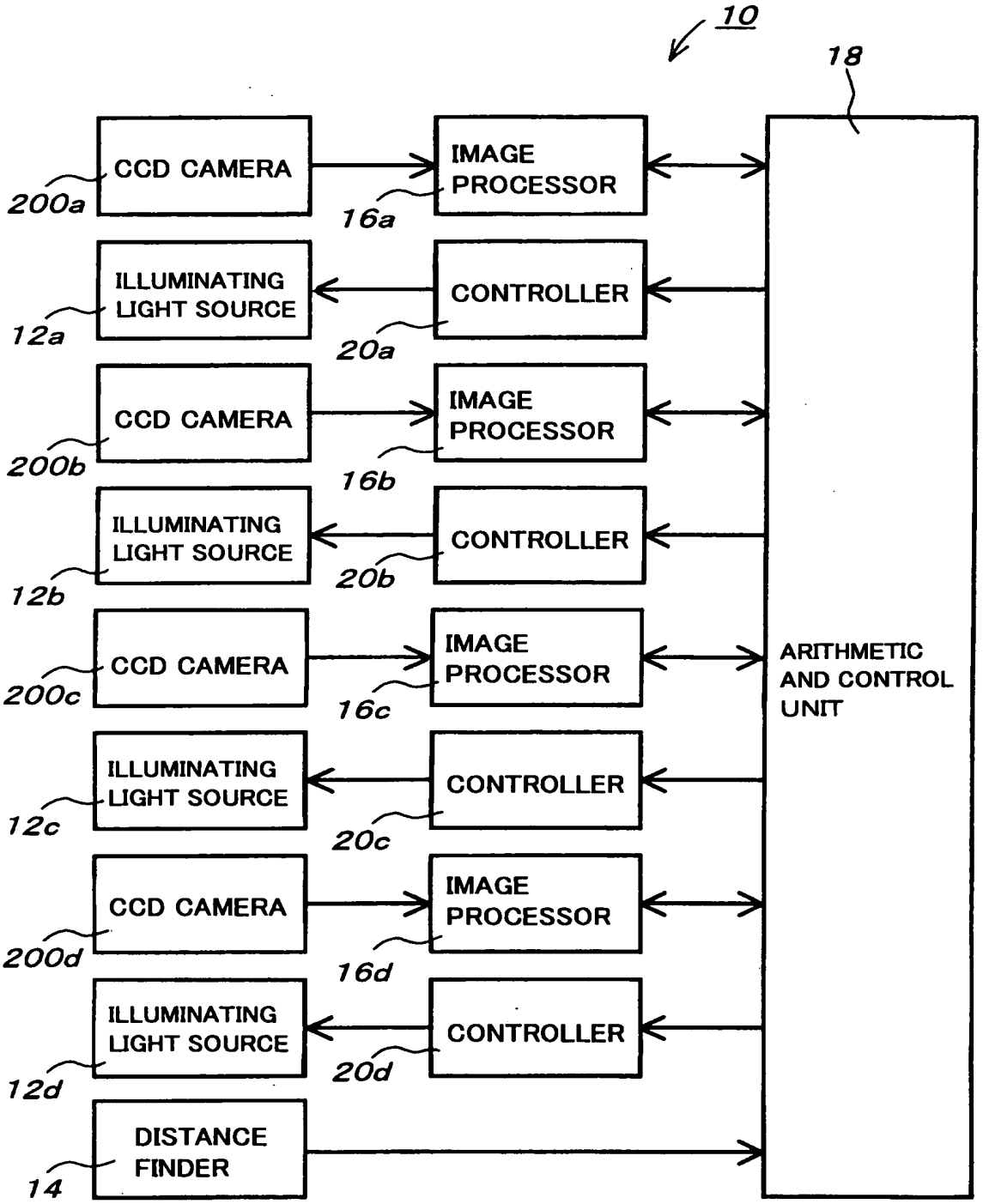


FIG. 3


10
18
CCD CAMERA
200a
IMAGE PROCESSOR
16a
ILLUMINATING LIGHT SOURCE
12a
CONTROLLER
20a
CCD CAMERA
200b
IMAGE PROCESSOR
16b
ILLUMINATING LIGHT SOURCE
12b
CONTROLLER
20b
CCD CAMERA
200c
IMAGE PROCESSOR
16c
ILLUMINATING LIGHT SOURCE
12c
CONTROLLER
20c
CCD CAMERA
200d
IMAGE PROCESSOR
16d
ILLUMINATING LIGHT SOURCE
12d
CONTROLLER
20d
DISTANCE FINDER
14
ARITHMETIC AND CONTROL UNIT

FOSE20 827F606

FIG. 4

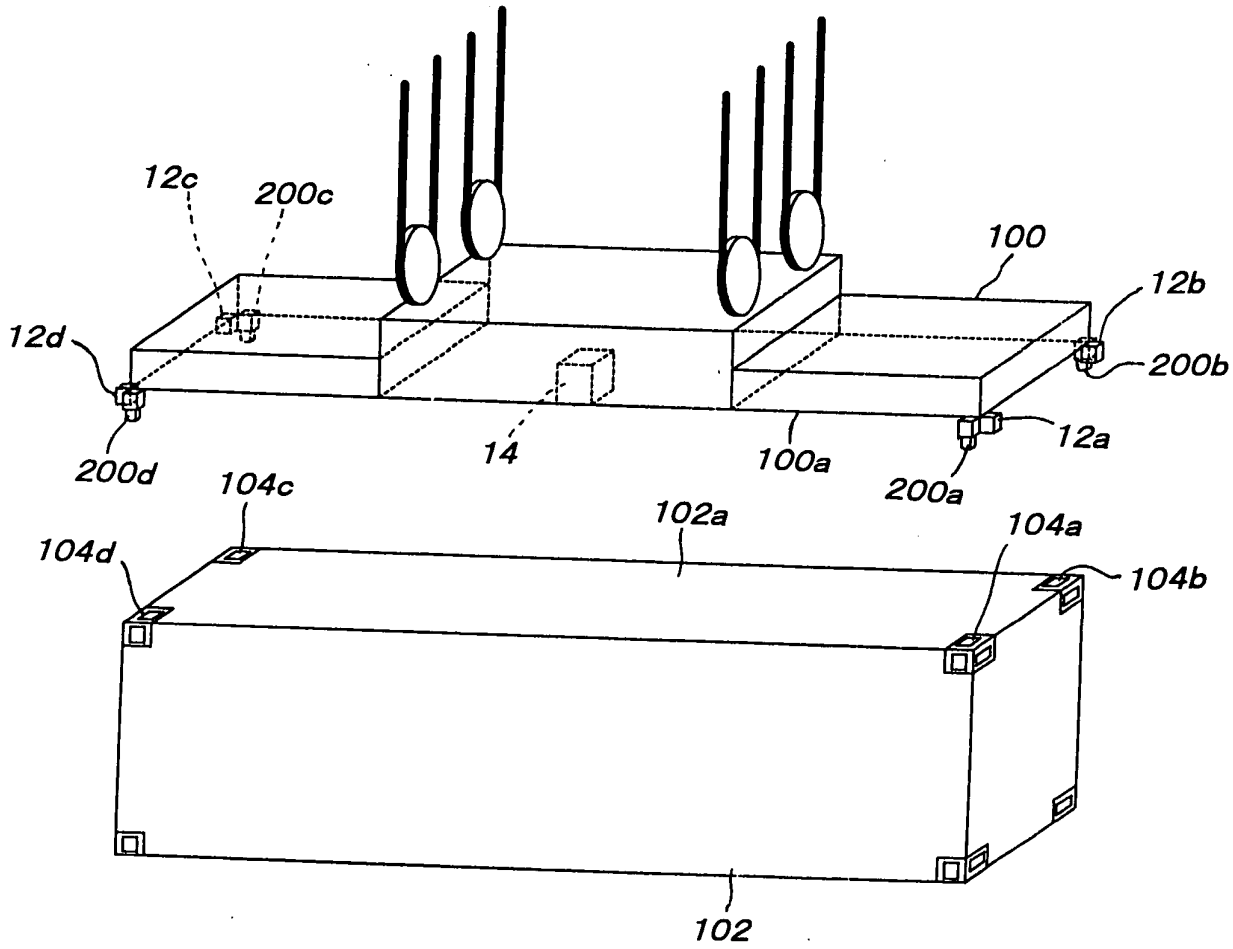


FIG. 5

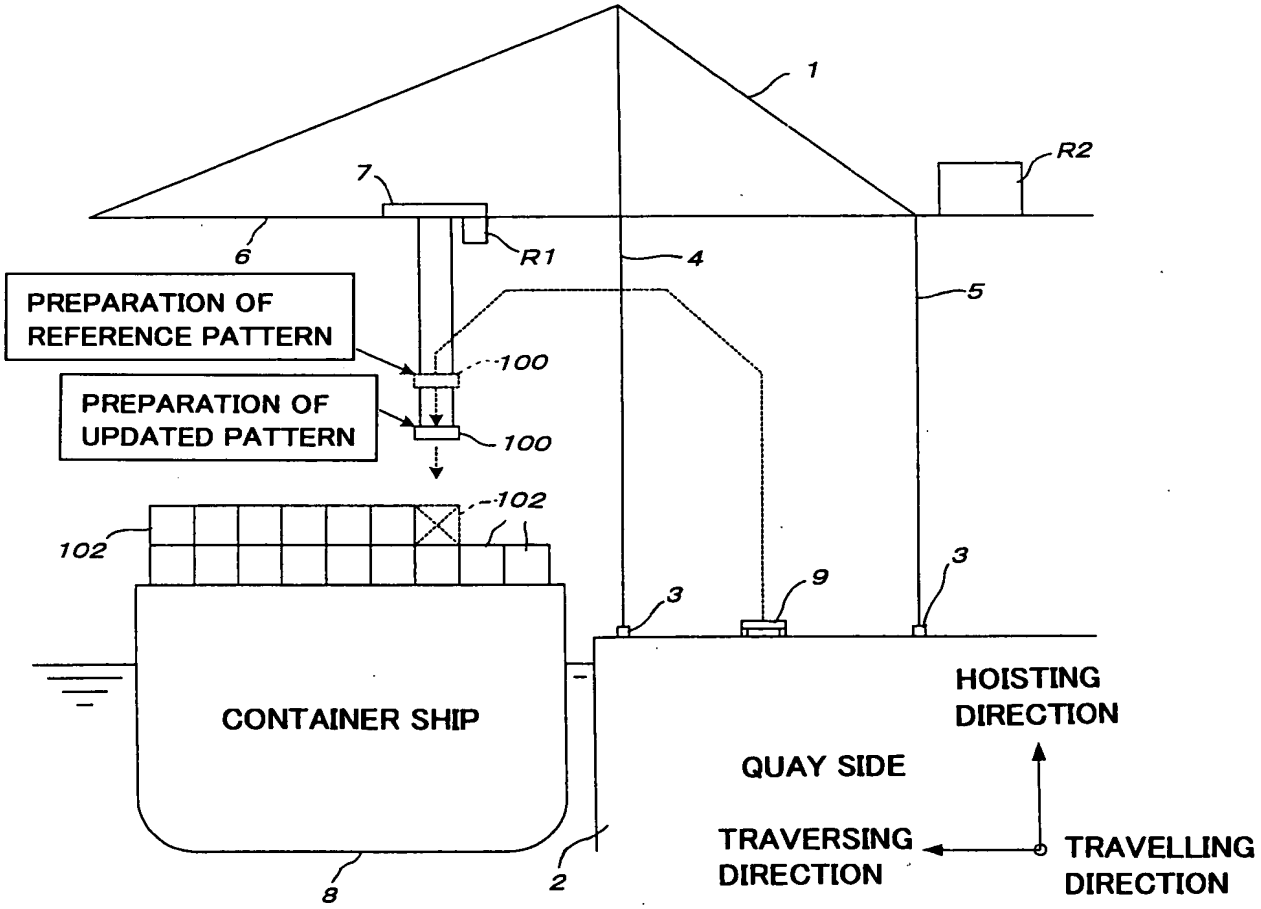

1
R2
7
6
R1
4
5
PREPARATION OF REFERENCE PATTERN
100
PREPARATION OF UPDATED PATTERN
100
102
102
3
9
3
CONTAINER SHIP
HOISTING DIRECTION
QUAY SIDE
TRAVERSING DIRECTION
TRAVELLING DIRECTION
8
2

FIG. 6

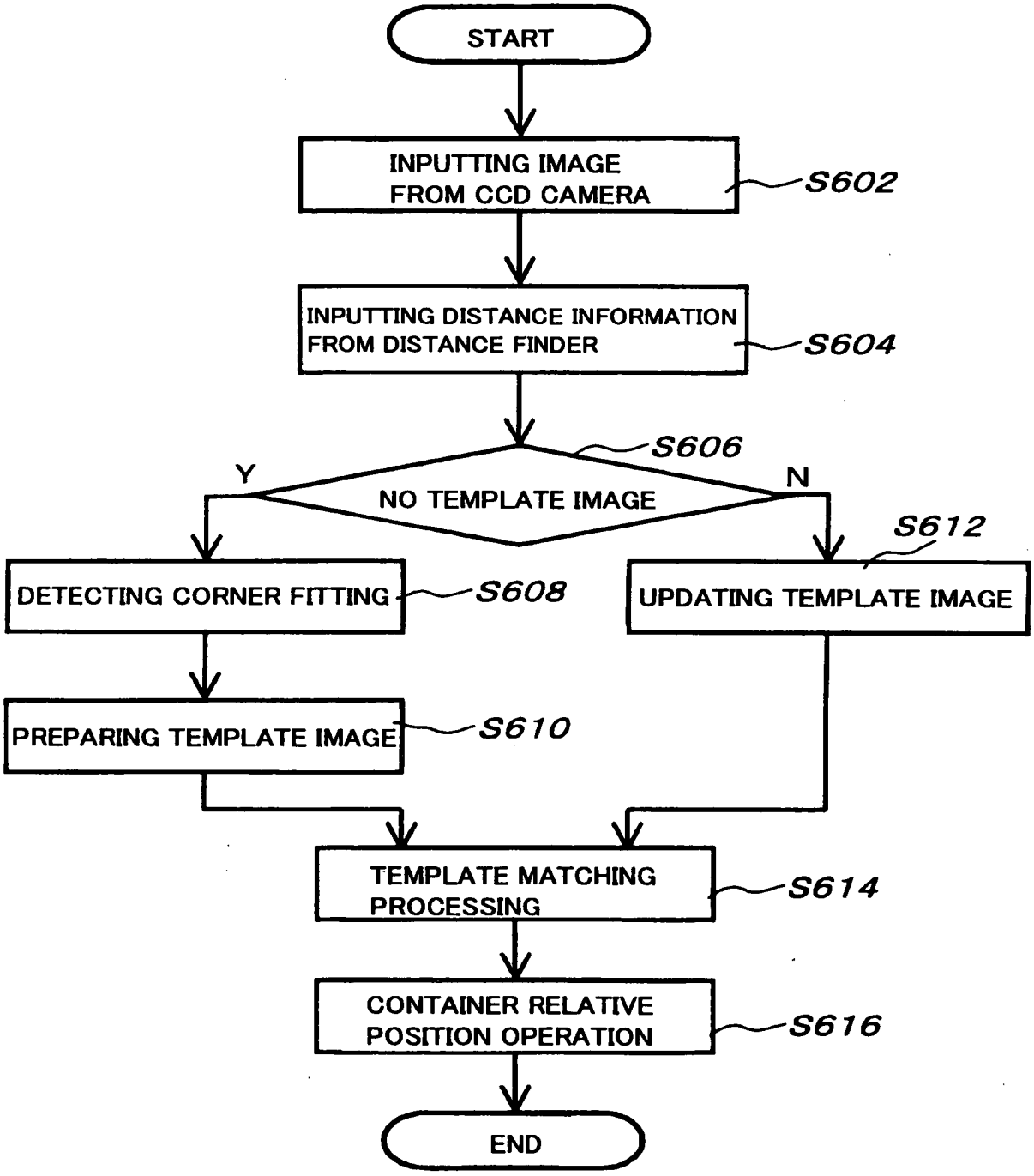
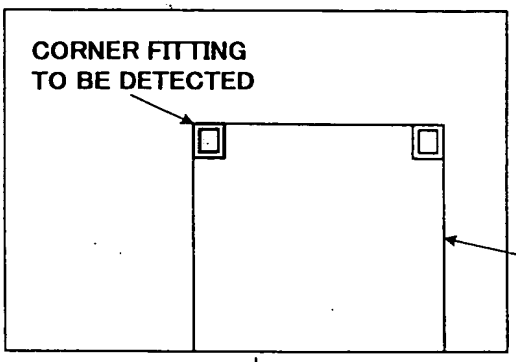
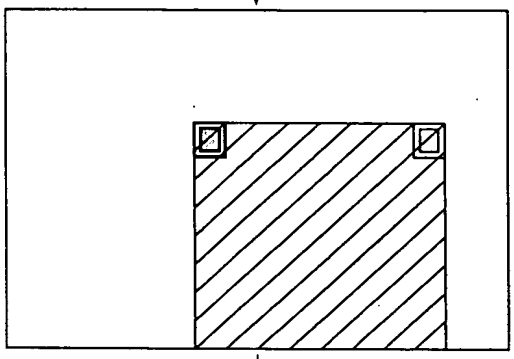

START
INPUTTING IMAGE FROM CCD CAMERA
S602
INPUTTING DISTANCE INFORMATION FROM DISTANCE FINDER
S604
S606
NO TEMPLATE IMAGE
Y
N
DETECTING CORNER FITTING
S608
S612
UPDATING TEMPLATE IMAGE
PREPARING TEMPLATE IMAGE
S610
TEMPLATE MATCHING PROCESSING
S614
CONTAINER RELATIVE POSITION OPERATION
S616
END

FIG. 7(a)



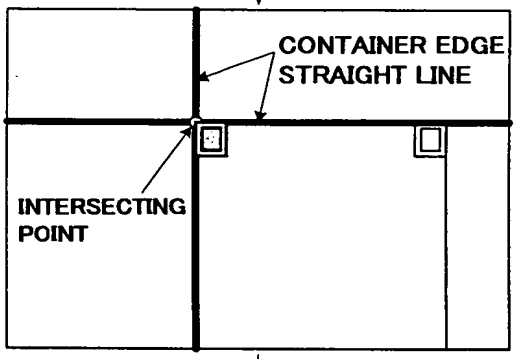
(a) ORIGINAL IMAGE

FIG. 7(b)



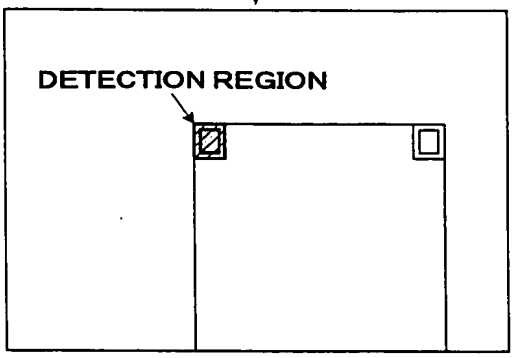
(b) DETECTION RESULT ON CONTAINER UPPER SURFACE

FIG. 7(c)

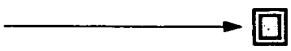


(c) RESULTS OF LINEAR APPROXIMATION OF CONTAINER EDGE AND INTERSECTING POINT DETECTION

FIG. 7(d)



(d) RESULT OF CONTAINER FITTING DETECTION



STORAGE AS TEMPLATE IMAGE (REFERENCE PATTERN)

FIG. 8

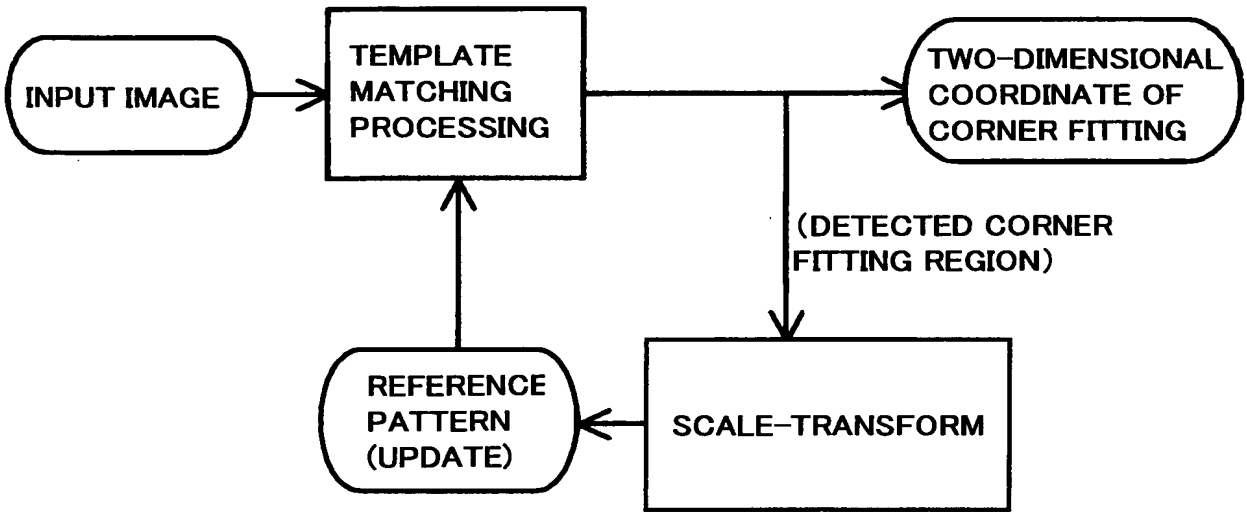

INPUT IMAGE
TEMPLATE MATCHING PROCESSING
TWO-DIMENSIONAL COORDINATE OF CORNER FITTING
(DETECTED CORNER FITTING REGION)
REFERENCE PATTERN (UPDATE)
SCALE-TRANSFORM

FIG. 9

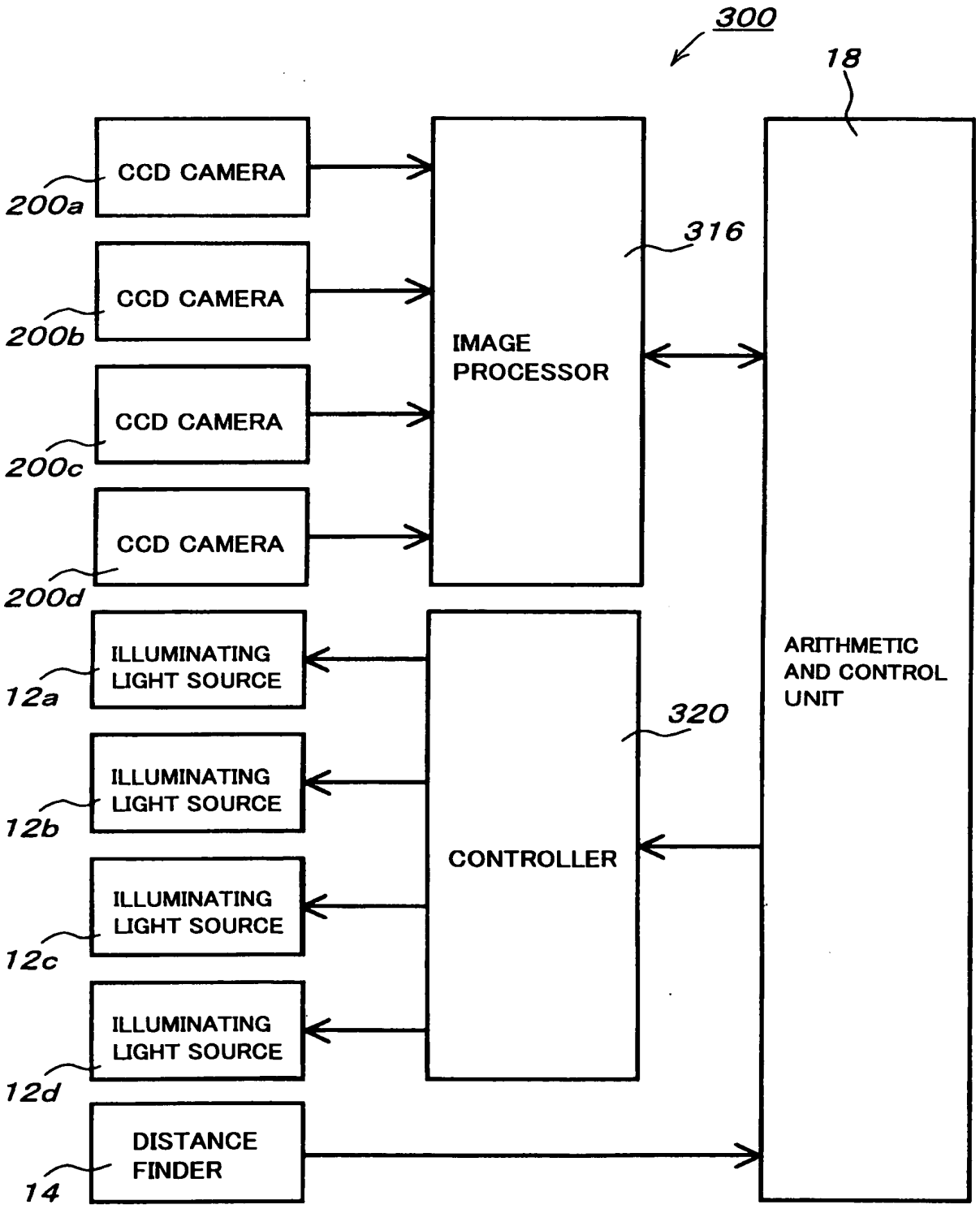
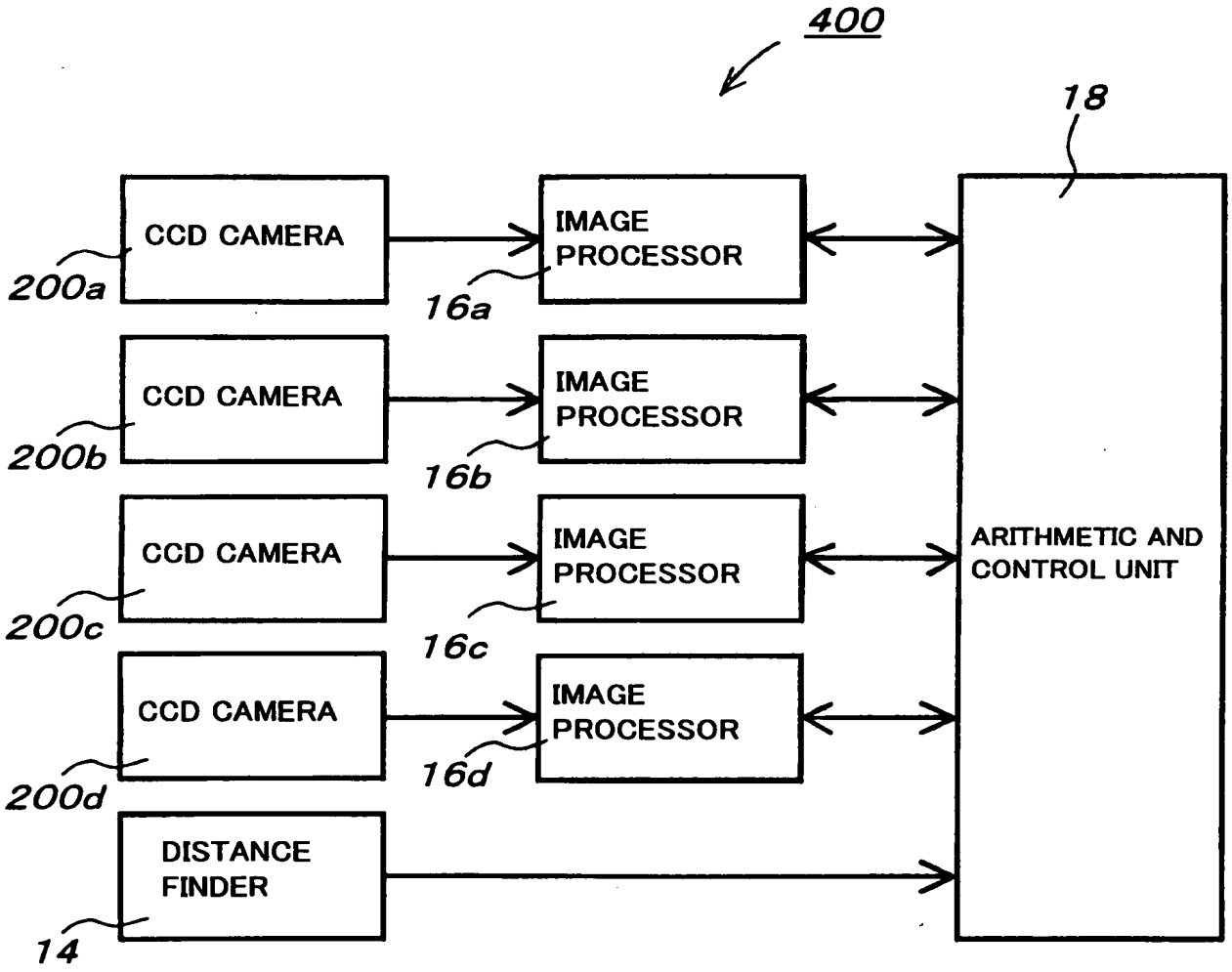

300
18
CCD CAMERA
200a
CCD CAMERA
200b
CCD CAMERA
200c
CCD CAMERA
200d
316
IMAGE PROCESSOR
ILLUMINATING LIGHT SOURCE
12a
ILLUMINATING LIGHT SOURCE
12b
ILLUMINATING LIGHT SOURCE
12c
ILLUMINATING LIGHT SOURCE
12d
320
CONTROLLER
ARITHMETIC AND CONTROL UNIT
DISTANCE FINDER
14

FIG. 10


400
18
CCD CAMERA
200a
IMAGE PROCESSOR
16a
CCD CAMERA
200b
IMAGE PROCESSOR
16b
CCD CAMERA
200c
IMAGE PROCESSOR
16c
CCD CAMERA
200d
IMAGE PROCESSOR
16d
DISTANCE FINDER
14
ARITHMETIC AND CONTROL UNIT

T05820 827T660

FIG. 11

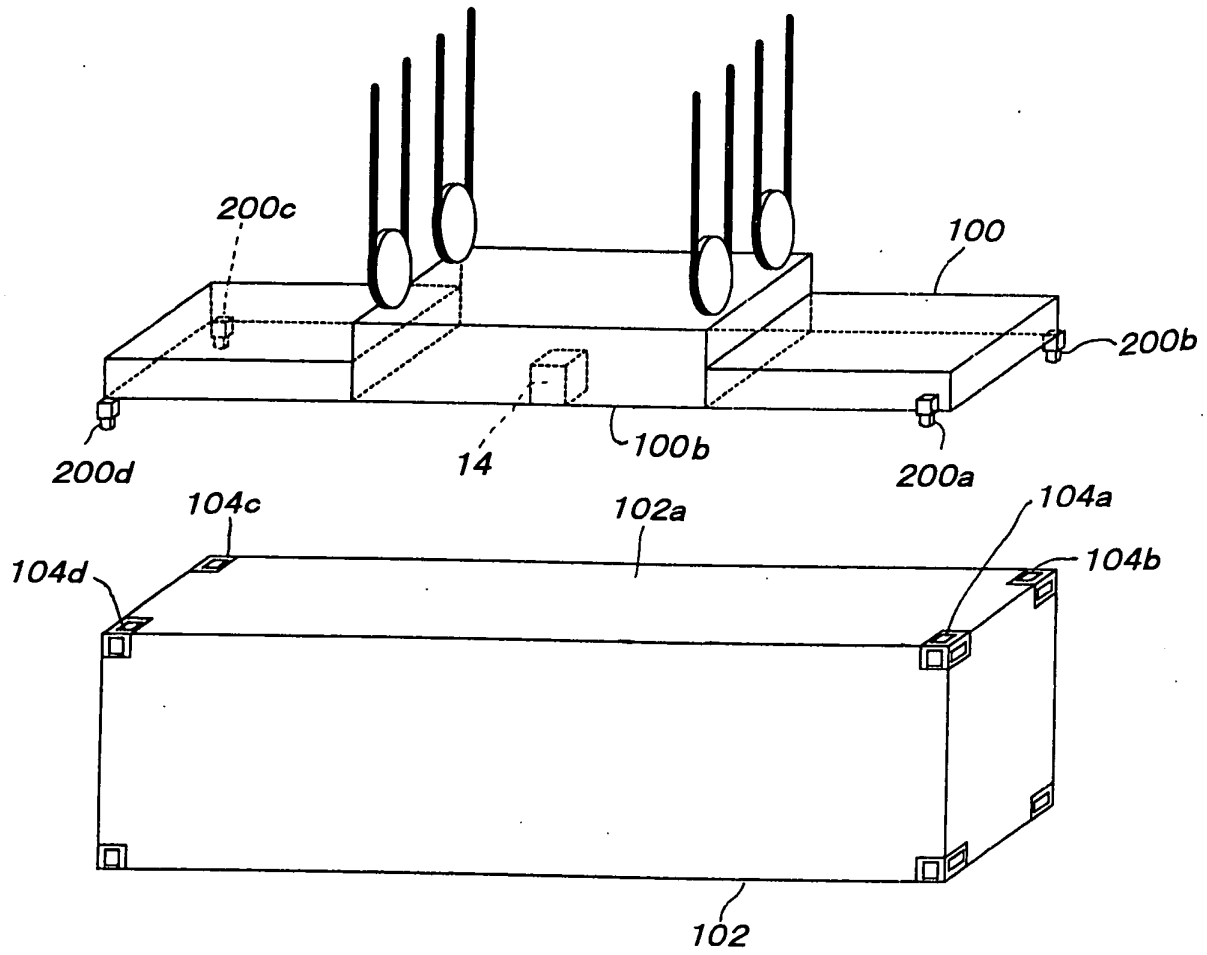


FIG. 12

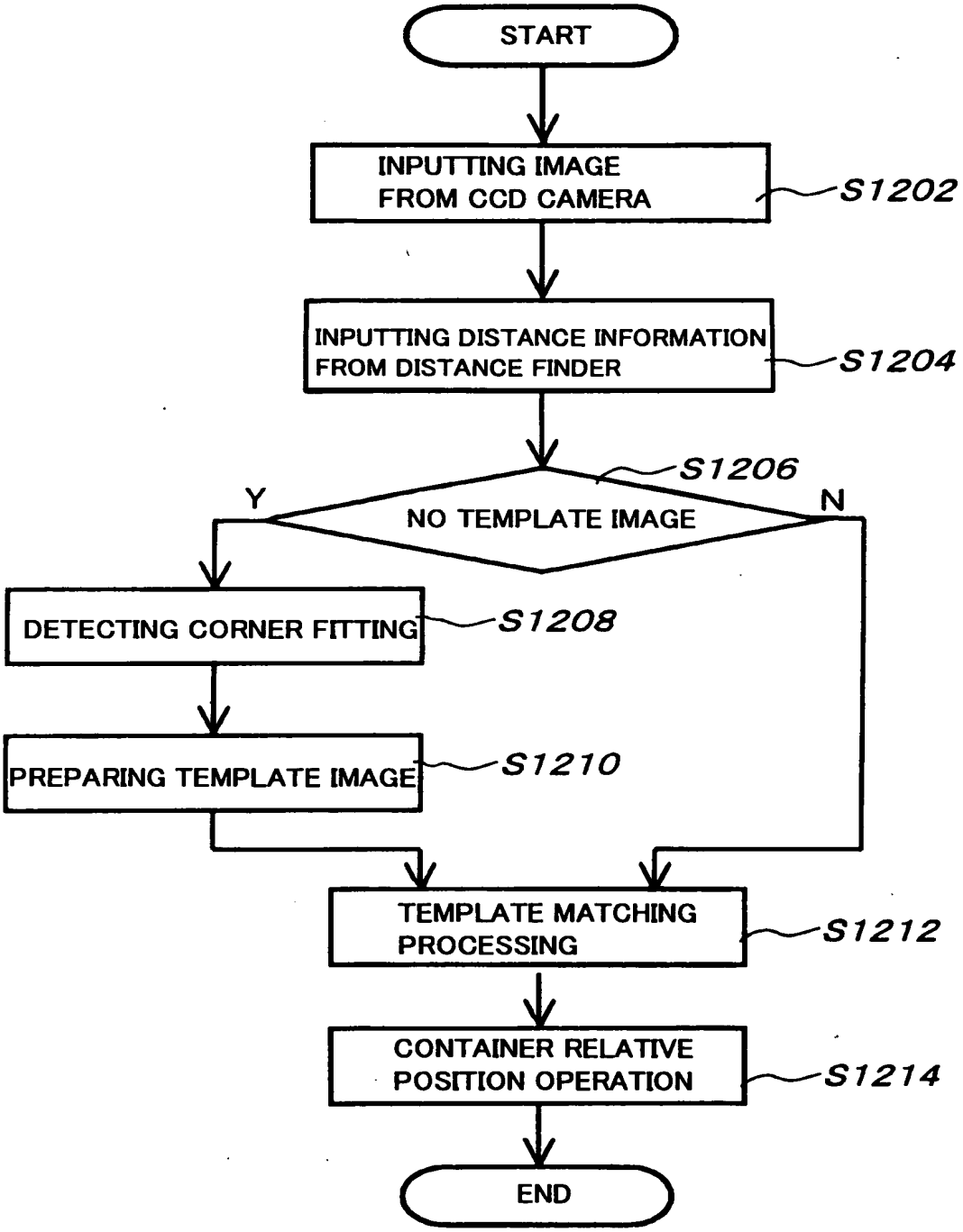

START
INPUTTING IMAGE FROM CCD CAMERA
S1202
INPUTTING DISTANCE INFORMATION FROM DISTANCE FINDER
S1204
S1206
NO TEMPLATE IMAGE
Y
N
DETECTING CORNER FITTING
S1208
PREPARING TEMPLATE IMAGE
S1210
TEMPLATE MATCHING PROCESSING
S1212
CONTAINER RELATIVE POSITION OPERATION
S1214
END

FIG. 13

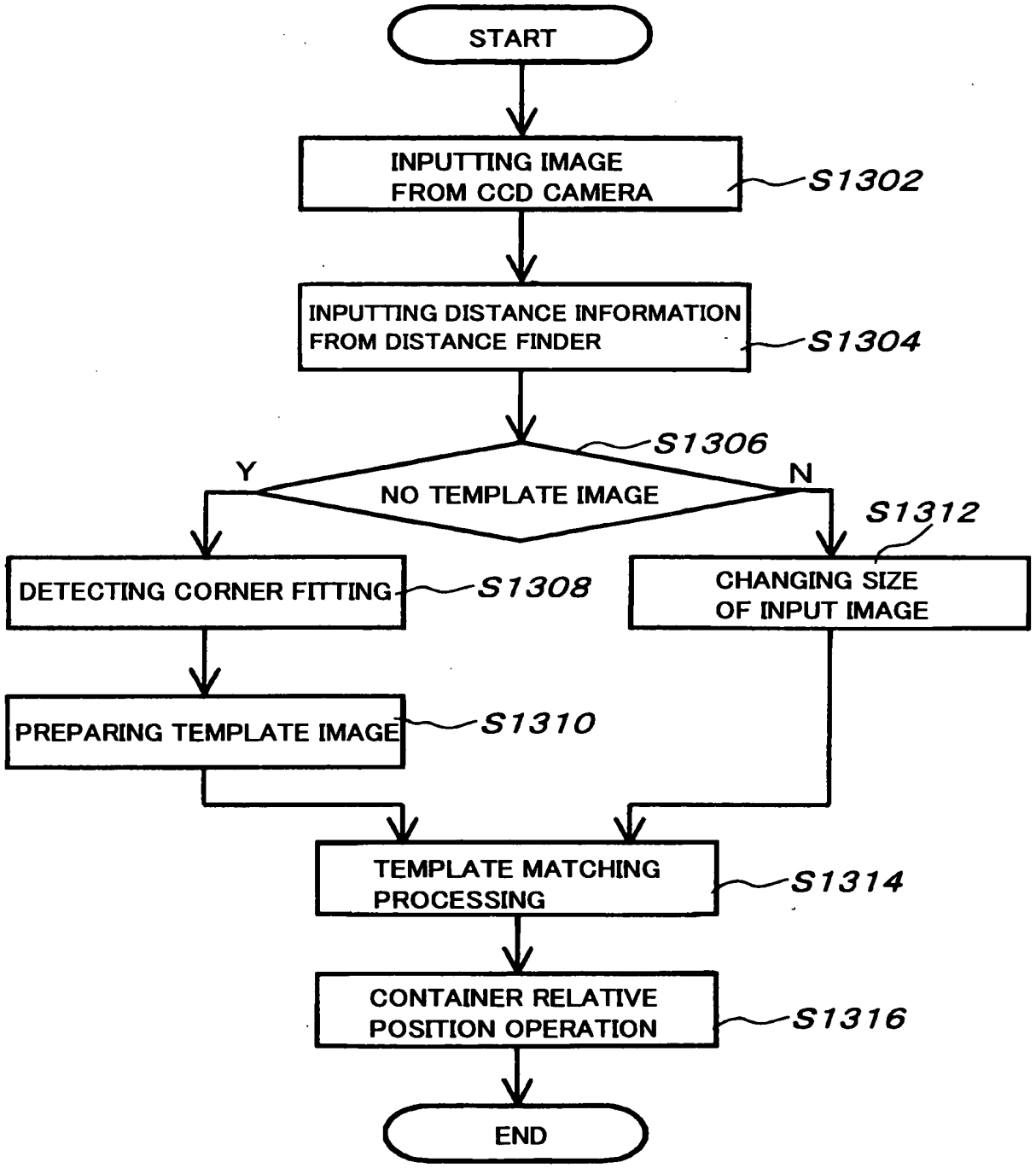

START
INPUTTING IMAGE FROM CCD CAMERA
S1302
INPUTTING DISTANCE INFORMATION FROM DISTANCE FINDER
S1304
S1306
NO TEMPLATE IMAGE
Y
N
S1312
DETECTING CORNER FITTING
S1308
CHANGING SIZE OF INPUT IMAGE
PREPARING TEMPLATE IMAGE
S1310
TEMPLATE MATCHING PROCESSING
S1314
CONTAINER RELATIVE POSITION OPERATION
S1316
END

FIG. 14

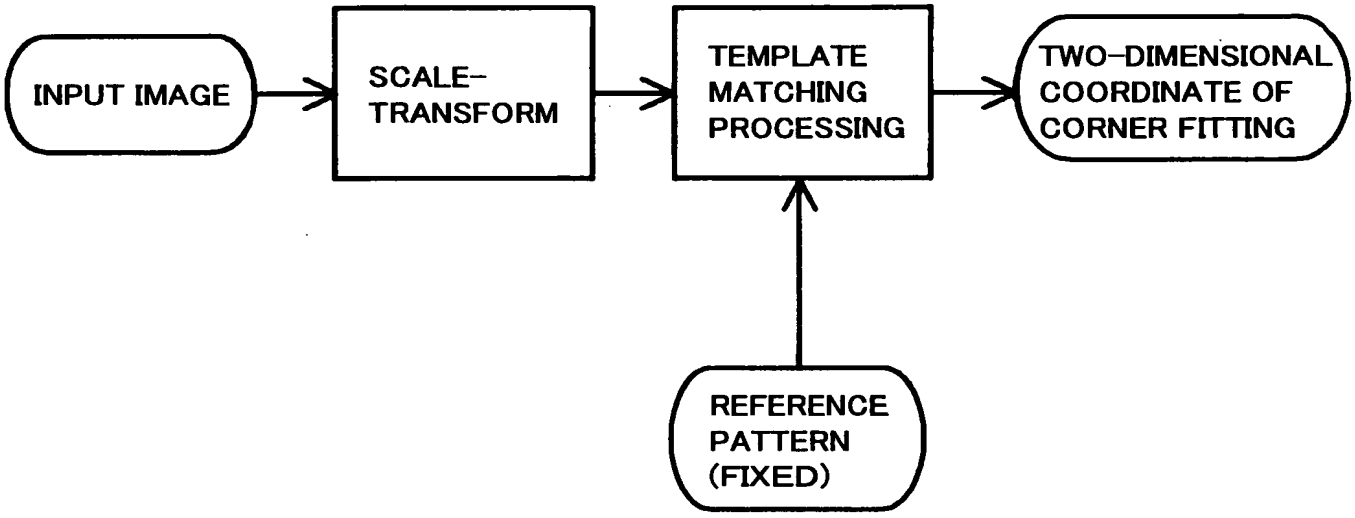

INPUT IMAGE
SCALE-TRANSFORM
TEMPLATE MATCHING PROCESSING
TWO-DIMENSIONAL COORDINATE OF CORNER FITTING
REFERENCE PATTERN (FIXED)

FIG. 15

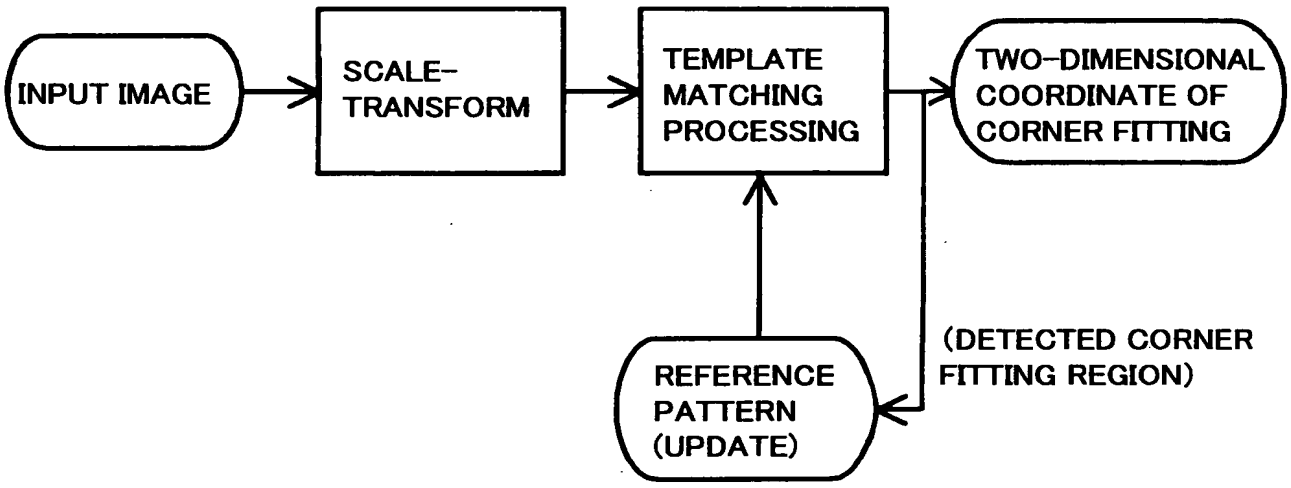

INPUT IMAGE
SCALE-TRANSFORM
TEMPLATE MATCHING PROCESSING
TWO-DIMENSIONAL COORDINATE OF CORNER FITTING
(DETECTED CORNER FITTING REGION)
REFERENCE PATTERN (UPDATE)

FIG. 16

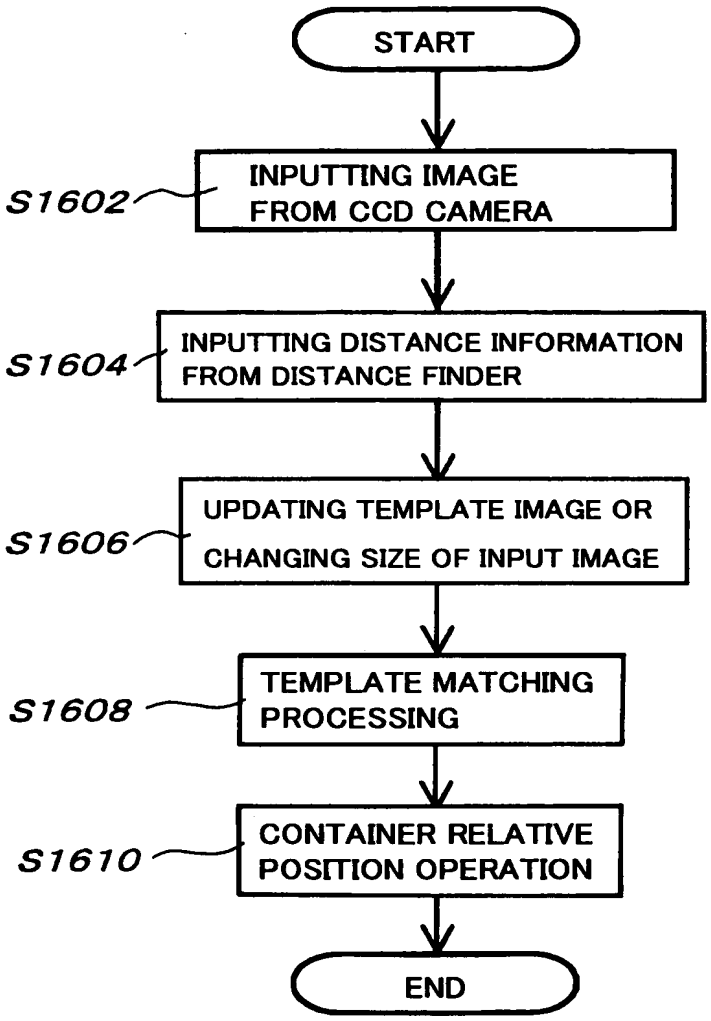

START
S1602
INPUTTING IMAGE FROM CCD CAMERA
S1604
INPUTTING DISTANCE INFORMATION FROM DISTANCE FINDER
S1606
UPDATING TEMPLATE IMAGE OR CHANGING SIZE OF INPUT IMAGE
S1608
TEMPLATE MATCHING PROCESSING
S1610
CONTAINER RELATIVE POSITION OPERATION
END

FIG. 17

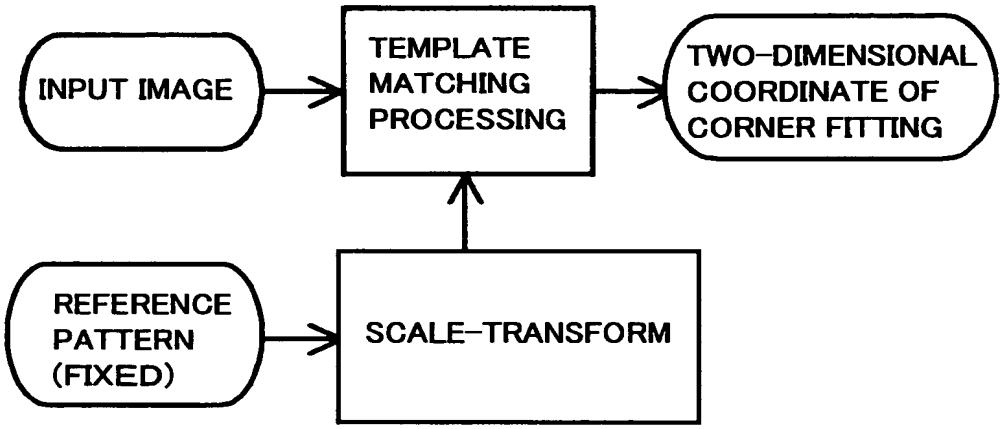
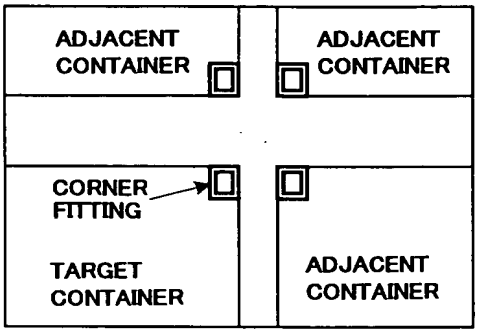
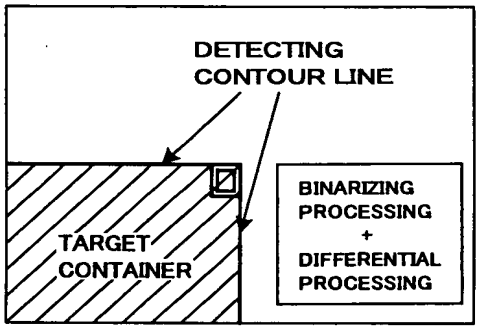

INPUT IMAGE
TEMPLATE MATCHING PROCESSING
TWO-DIMENSIONAL COORDINATE OF CORNER FITTING
REFERENCE PATTERN (FIXED)
SCALE-TRANSFORM

FIG. 18(a)



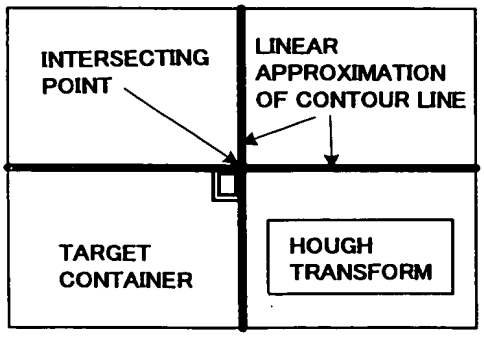
ORIGINAL IMAGE

FIG. 18(b)



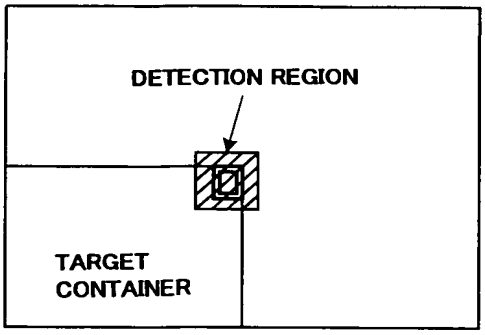
DETECTION RESULT ON CONTAINER UPPER SURFACE

FIG. 18(c)



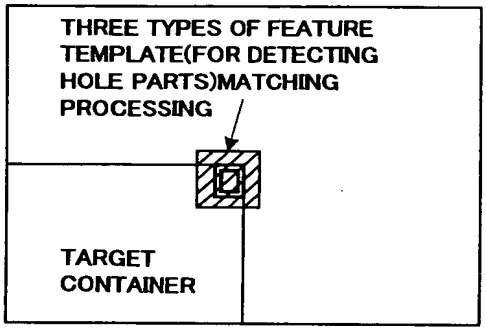
RESULTS OF LINEAR APPROXIMATION OF CONTOUR LINE AND INTERSECTING POINT DETECTION

FIG. 18(d)



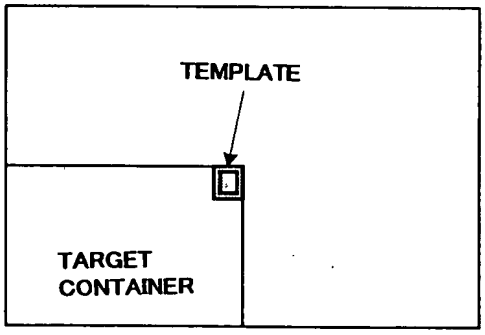
SETTING-UP OF DETECTION REGION

FIG. 18(e)



FEATURE TEMPLATE (FOR DETECTING HOLE PARTS) MATCHING PROCESSING

FIG. 18(f)



RESULT OF TEMPLATE PREPARATION

FIG. 19(a)

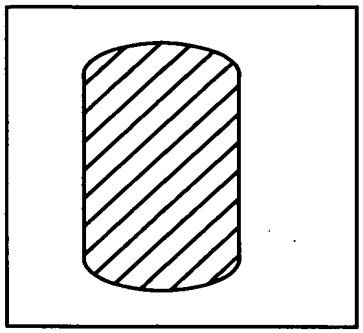
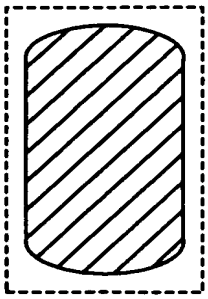


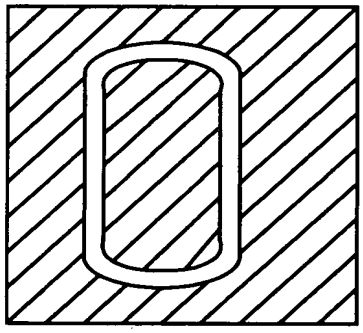
IMAGE DATA HAVING LOW CONCENTRATION IN HOLE PART

FIG. 19(c)



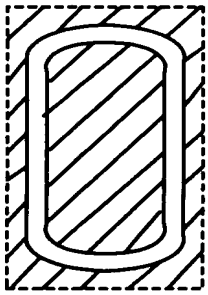
FEATURE TEMPLATE (FOR DETECTING HOLE PARTS) IMAGE 1

FIG. 19(b)



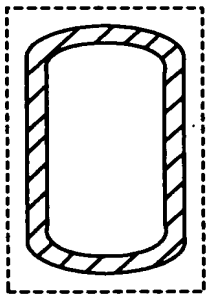
RESULT OF DIFFERENTIAL PROCESSING

FIG. 19(d)



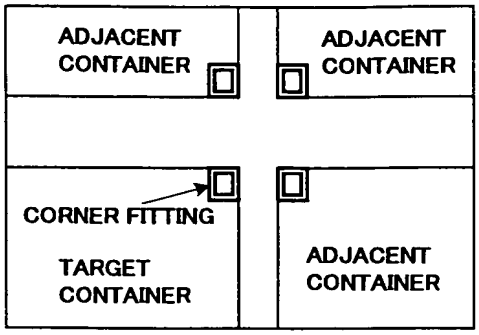
FEATURE TEMPLATE (FOR DETECTING HOLE PARTS) IMAGE 2

FIG. 19(e)



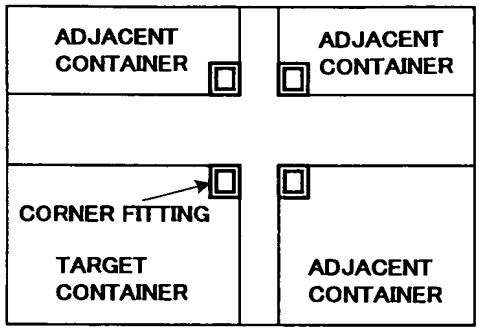
FEATURE TEMPLATE (FOR DETECTING HOLE PARTS) IMAGE 3

FIG. 20(a)



ORIGINAL IMAGE

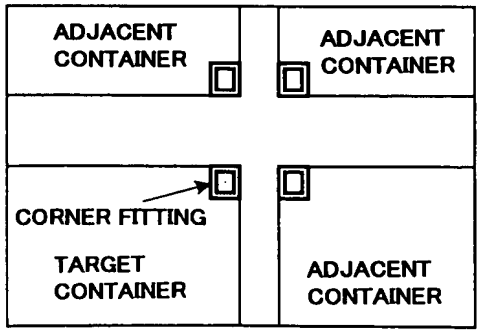
FIG. 20(b)



FEATURE TEMPLATE
(FOR DETECTING HOLE PARTS)
MATCHING PROCESSING

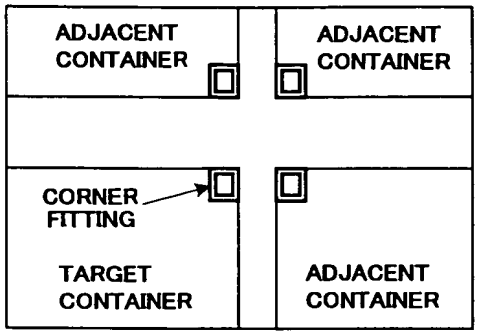
THREE TYPES OF FEATURE TEMPLATE
(FOR DETECTING HOLE PARTS)
MATCHING PROCESSING
(WHOLE IMAGE DATA)

FIG. 20(c)



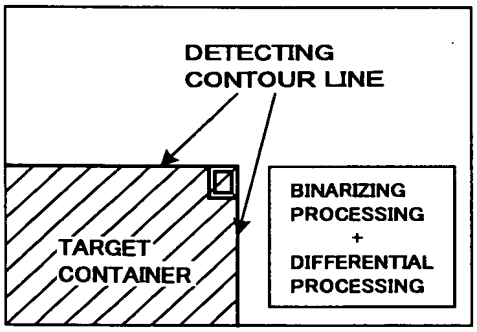
RESULT OF TEMPLATE
PREPARATION

FIG. 21(a)



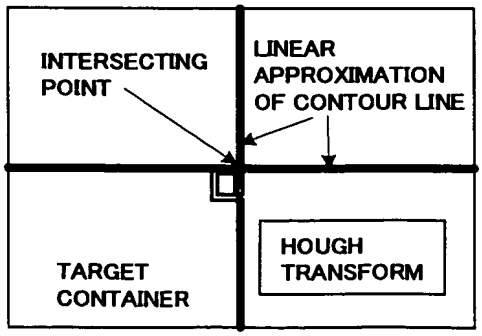
ORIGINAL IMAGE

FIG. 21(b)



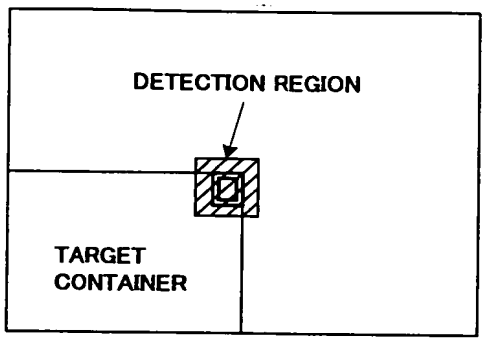
DETECTION RESULT ON CONTAINER UPPER SURFACE

FIG. 21(c)



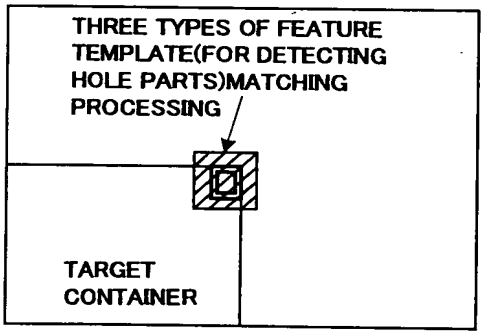
RESULTS OF LINEAR APPROXIMATION OF CONTOUR LINE AND INTERSECTING POINT DETECTION

FIG. 21(d)



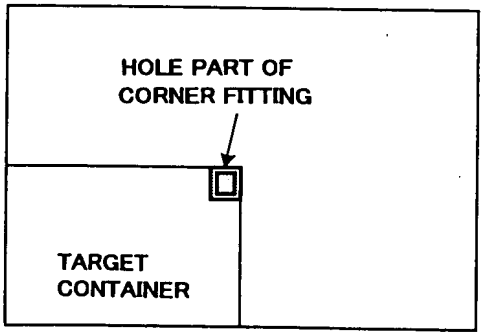
SETTING-UP OF DETECTION REGION

FIG. 21(e)



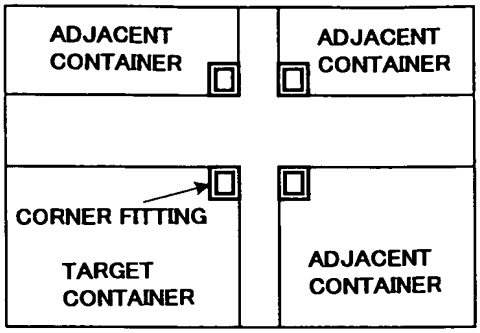
FEATURE TEMPLATE (FOR DETECTING HOLE PARTS) MATCHING PROCESSING

FIG. 21(f)



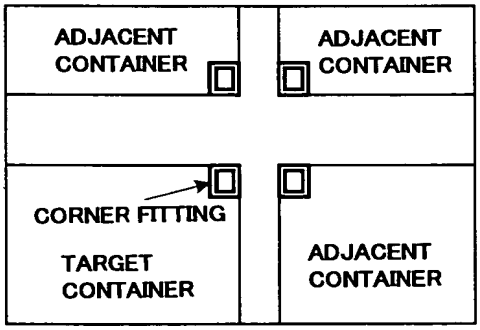
RESULT OF TEMPLATE PREPARATION

FIG. 22(a)



ORIGINAL IMAGE

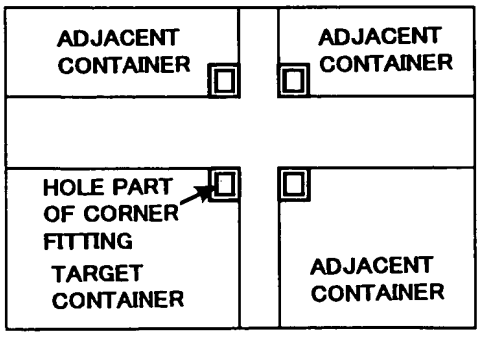
FIG. 22(b)



FEATURE TEMPLATE
(FOR DETECTING HOLE PARTS)
MATCHING PROCESSING

THREE TYPES OF FEATURE TEMPLATE
(FOR DETECTING HOLE PARTS)
MATCHING PROCESSING
(WHOLE IMAGE DATA)

FIG. 22(c)



RESULT OF TEMPLATE
PREPARATION